IMPACT-ABSORBING END CAPS FOR LEVELS

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IMPACT-ABSORBING END CAPS FOR LEVELS

FIELD OF THE INVENTION

This invention relates to geometric instruments and, more particularly, to levels (sometimes referred to as "spirit levels" used by carpenters and the like.

BACKGROUND OF THE INVENTION

Levels are used by carpenters, masons, drywallers and the like for helping to assure that surfaces are horizontal, vertical, or at a specified angular relationship to the horizon. A typical level includes at least two vials, one each for ascertaining whether a surface is "level," i.e., horizontal, or "plumb," i.e., vertical.

A level comprises a measuring surface or surfaces and a vial set at an angular relationship to such surface(s). The vial is partially filled with a liquid such as mineral spirits. The vial is not completely filled and a bubble is thereby formed when the vial is closed. Typically, two marker rings are applied to the outside of the vial in positions to visually divide the cavity into three portions of about equal length. Level and plumb conditions are ascertained by noting the position of the bubble with respect to the marker rings.

A problem with such levels is that the vials and, to a lesser extent, the level's body can be damage easily during use. Levels are often left in position on a surface to be measured or set and can be knocked off causing them to fall to the ground. In addition, many levels have a greater length, frequently about four feet, and may be bumped or knocked by those who are more accustomed to dealing with tools of smaller dimensions. In addition, the great length of some levels causes an increase in weight which can add to stresses involved with falling or being bumped.

Therefore, there is a need to provide a device and method for reducing stress on level bodies and vials. Such a device and method would be an improvement upon the prior art. An improved level which includes impact-absorbing end caps to permit levels to withstand falls and bumps which typically cause damage to prior art level would solve the noted problems of the prior art.

OBJECTS OF THE INVENTION

It is an object of the invention to provide an improved level overcoming some of the problems and shortcomings of the prior art.

Another object of the invention is to provide a level which includes dual-density end caps which provide for impact absorption.

Another object of the invention is to provide a level which allows for compression of its end caps when impacted.

Another object of the invention is to provide a level which includes baffled end caps for to facilitate compression of its end caps when impacted.

Another object of the invention is to provide a level having ends which are protected from contact by foreign objects.

Yet another object of the invention is to provide a level having increase impact-resistance with little additional weight.

Another object of the invention is to provide a new method for making the new level.

Another object of the invention is to provide a new method which results in a level having coextensive end caps such that the profile of the end caps does not interfere during measurements. How these and other objects are accomplished will become apparent from the following descriptions and from the drawings.

SUMMARY OF THE INVENTION

In at least one embodiment, the invention is a level which provides for absorption of impacts to the level's ends. The invention represents a significant advance over the state of the art by providing novel elements, including a dual component end cap attached to the end of the level.

In certain embodiments, the impact-absorbing level comprises a body including a level face for measuring a surface, the body extending from a first end to a second end; at least one vial mounted in the body at a predetermined angular relationship to the level face; and a first end cap fixed with respect to the first end, the first end cap comprising an outer layer and an intermediate layer, the intermediate layer fixed to the outer layer and having lower density than the outer layer, the intermediate layer positioned between the outer layer and the body. In such a level, the first end cap absorbs impacts to the outer layer to prevent damage to the body.

The level may further includes a second end cap fixed with respect to the second end, the second end cap comprising an second outer layer and a second intermediate layer, the second intermediate layer fixed to the second outer layer and having lower density than the second outer layer, the second intermediate layer positioned between the second outer layer and the body. The second end cap absorbs impacts to the second outer layer to prevent damage to the body.

In some preferred embodiments, the outer layer has a higher density than the intermediate layer and is less compressed than the intermediate layer during an impact. In such embodiments, the outer layer may preferably be acrylonitrile butadiene styrene and the intermediate layer may preferably be thermoplastic rubber though other materials may be used. The outer layer and intermediate layer are preferably bonded together, either through adhesion resulting from heat processing, through use of an addition adhesive which is able to bond strongly to both the outer and intermediate layers, or through other methods.

Each end cap preferably further comprises an inner layer having a higher density than the intermediate layer, the inner layer connecting the intermediate layer to the body. In such embodiments, the outer layer is preferably acrylonitrile butadiene styrene, the intermediate layer is preferably thermoplastic rubber, and the inner layer is

preferably acrylonitrile butadiene styrene. Again, such layers are preferably bonded together by heat processing, use of an additional adhesive which is able to bond strongly to each layer, or other methods.

In certain embodiments, the outer, intermediate and inner layers extend from a bottom surface to a top surface, the inner and outer layers are comprised of a first material and the end caps further include a web layer comprised of the first material and further connecting the inner and outer layers. Such a web layer may be integrally formed with the outer and/or inner layers and intersects the intermediate layer.

The body defines a body profile at its ends, the outer layer defines an outer profile which matches the body profile, the intermediate layer includes a baffled profile including portions matching the body profile and portions smaller than the body profile, and the inner layer defines an inner profile which matches the body profile and it bonded or adhered thereto such that each end cap is bonded or adhered to the body.

The invention can also be considered an improvement upon a level including (a) a body extending from a first end to a second end, (b) a level face connected with respect to the body, the level face for measuring a surface, and (c) a vial mounted with respect to the body at a predetermined angular relationship to the level face. Such improvement includes a first dual-density end cap mounted to the first end and a second dual-density end cap mounted to the second end, the end caps having an outer layer and an intermediate layer, whereby impacts to an end cap result in compression of the end cap and dissipation of the impact to prevent damage to the level.

In such an improvement, the intermediate layers preferably have lower densities than the outer layers and are compressed more easily than the outer layers. The outer layers may be acrylonitrile butadiene styrene and the intermediate layers may be thermoplastic rubber though other materials may be used to accomplish the impact-absorption function while providing for sufficient bonding between one another and to the body of the level. The end caps may further comprise inner layers connecting the intermediate layers to the body. The intermediate layers preferably have lower densities than both the inner and outer layers and are compressed more easily than both the inner and outer layers. It is preferred that the inner layers be acrylonitrile butadiene styrene.

In the improvement, the body of the level defines a body profile at the ends with the outer layers defining outer profiles which match the body profile, and the intermediate layers including baffled profiles having portions matching the body profile and portions smaller than the body profile. It is preferred that the outer layers be bonded to the intermediate layers, the intermediate layers be bonded to the inner layers, and the inner layers be bonded to the ends.

The invention also includes a method of providing impact-absorption to a level. Such a method comprises providing a level having a body defined by first and second ends; and adhering a dual-density end cap to each end, each end cap having an intermediate layer for connection with respect to a respective end and an outer layer for connection to a respective intermediate layer, the outer layer having an outer surface. In such a method, each end cap absorbs impacts to the respective outer surface by allowing the respective outer surface to be moved toward the respective end during the respective impact. Each end cap preferably includes an inner layer for connection to a respective end and to a respective intermediate layer. The intermediate layers preferably have lower densities than the outer layers and the intermediate layers are preferably compressed more than the outer layers during an impact.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view of a level having impact-absorbing end caps in accordance with an embodiment of the invention.

FIGURE 2 is a perspective view of a level having impact-absorbing end caps in accordance with another embodiment of the invention

FIGURE 3 is a front elevation of the level of FIGURE 1 in contact with a surface to be measured.

FIGURE 4 is an end view of an end of the body of the level in accordance with the principles of an embodiment of the present invention.

FIGURE 5 is an end view of the outer surface of the outer layer of an end cap in accordance with the principles of an embodiment of the present invention.

FIGURE 6 is a cross section view of portions of the intermediate layer in accordance with the principles of an embodiment of the present invention.

FIGURE 7 is an exploded view of an end cap shown in FIGURE 1.

FIGURE 8 is an exploded view of an end cap shown in FIGURE 2.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIGURES 1 and 2 are perspective views of alternate levels 10 having impact-absorbing end caps 20,30. Each level 10 includes a body 11 having a level face 12 for measuring a surface 13 (see FIGURE 3), the body extending from a first end 14 to a second end 15. Each level 10 further includes at least one vial 16 mounted in body 11 at a predetermined angular relationship to level face 12, such as parallel to, perpendicular to, or at another specific angle to level face 12..

First dual-density end cap 20 is fixed with respect to first end 14 and comprises an outer layer 21, an intermediate layer 22, and an inner layer 23. Outer layer 21 is fixed or bonded to intermediate layer 22 which is fixed or bonded to inner layer 23. Intermediate layer 22 has a lower density than outer layer 21 and inner layer 23 such that intermediate layer is compressed more easily and to a greater degree during impacts. Outer and inner layers 21,23 are preferably acrylonitrile butadiene styrene and intermediate layer 22 is preferably thermoplastic rubber. When the level is dropped or the outer surface 18 of first end cap 20 otherwise strikes a surface, first end cap 20 is compressed such that the distance between at least a portion of outer layer 21 and the end 14 of level 10 is reduced. In this manner, first end cap 20 absorbs impacts to the outer layer 21 to prevent damage to the body 11.

Second dual-density end cap 30 is fixed with respect to second end 15and comprises an outer layer 31 an intermediate layer 32, and an inner layer 33. Outer layer 31 is fixed or bonded to intermediate layer 32 which is fixed or bonded to inner layer 33. Intermediate layer 32 has a lower density than outer layer 31 and inner layer 33 such that intermediate layer is compressed more easily and to a greater extent during impacts. Outer and inner layers 31,33 are preferably acrylonitrile butadiene styrene and intermediate layer 32 is preferably thermoplastic rubber. When the level is dropped or the outer surface 37 of second end cap 30 otherwise strikes a surface, second end cap 30 is compressed such that the distance between at least a portion of outer layer 31 and the end 15 of level 10 is reduced. In this manner, second end cap 30 absorbs impacts to the outer layer 31 to prevent damage to the body 11.

In FIGURES 1 and 2 the outer layers 21,31, intermediate layers 22,32, and inner layers 23,33 extend from a bottom surface 24,34 to a top surface 25,34. In

FIGURE 2, each end cap 20,30 further includes a web layer 26,36 further connecting outer layers 21,31 and inner layers 23,33. Web layer 26,36 is preferably comprised of the same material as outer layers 21,31 and inner layers 23,33 and may be integrally formed with both or either of those layers.

FIGURES 4, 5, and 6 show the profiles of various level components. FIGURE 4 is a cross section view of the level body 11 near an end 14,15 and shows body profile 17 as having a rectangular shape with an area. FIGURE 5 is a cross section of outer layer 21 and shows outer profile 27 matching body profile 17, that is, it has the same rectangular shape and area as body profile 17. FIGURE 6 shows two cross section views of baffled intermediate layer 22 having intermediate profile 28. In its expanded portion 29 shown on the left, intermediate profile 28 matches body profile 17 and outer profile 27. In its reduced portion 19 shown on the right, intermediate profile 28 has a smaller area than body profile 17 and outer profile 27. Such a design aids compression of intermediate layer 22 during impacts. In addition, because the outer, intermediate, and inner layers 21,22,23 include no profiles greater than the body profile 17, end caps 20,30 never interfere with level measurements performed by level 10.

FIGURES 7 and 8 are exploded view of first dual-density end caps 20 shown in FIGURES 1 and 2. FIGURE 8 shows the inclusion of web layer 26 which may comprise two separate portions as shown. Web layer 26 may be integrally formed with either or both outer layer 21 or inner layer 23 or may be a separate piece bonded to each of the layers 21,22,23.

Thus, it should be apparent that there has been provided, in accordance with the present invention, a vial for use with levels that fully satisfies the objectives and advantages set forth above.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.